Energy, Mines and Resources Canada
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HCMM/SOIL MOISTURE EXPERIMENT

Investigation Number: HCM-054

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PROGRESS REPORT
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TITLE: HCMM/Soil Moisture Experiment

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1. Introduction

During the reporting period, progress has been made in the compilation and analysis of data. All available airborne and ground data have been tabulated, entered into computer, and some correlation and regression analysis has been carried out. An overview of these data is given in Section 2. Three suitable HCMM images (cloudfree over the areas of interest and of good quality) have been selected and ordered in digital form on 12 May, 1980. To date, two scenes have been received and reviewed. A cloud cover study over the western site was completed, and a preliminary visual analysis of available satellite data has been conducted.

2. Techniques

The airborne and related ground data were entered into computer in several files, each file containing information for one or more crop. Several parameters pertaining to the data were coded to permit selecting subsets based on various criteria. Table 1 contains a list of files and of data they contain. Ground PRT-5 measurements were tabulated and are being analysed manually.

HCMM digital data have been read on the CCRS Image Analysis System (CIAS; Goodenough, 1977) using universal input format. Since this program has not been written specifically for HCMM data, some difficulties were initially experienced. However, the supplied tapes can now be read, and the sites of interest are transferred to another tape for ease of handling.

All HCMM images provided for the western site have been analyzed to determine the effect of cloud cover on the availability of HCMM-type data in an operational system. Using known landmarks, a geographically - referenced grid (2° latitude by 2° longitude), was drawn to conform to the distortion of HCMM images. Within each grid cell, cloud cover was estimated visually. This procedure was carried out for each available scene, between 1 June and 31 August 1978 separately for day and night images. Summary maps were prepared for each month, both day and night.

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Table 1. Airborne and related ground data for regression analysis.

File Name	Crop Type	Site (Plot or Field)	Month and Year
PFB89.DAT	Faba Beans	Plot	8/78
	Faba Beans	Plot	6/78
	Faba Beans	Field, Plot	7, 8/79
	Dry Beans	Field, Plot	7, 8/79
PLCP89.DAT	Potatoes	Plot	8/78
	Potatoes	Plot	6/78
	Cabbage	Plot	7, 8/79
	Cabbage	Plot	8/78
	Cabbage	Plot	6/78
PFA89.DAT	Alfalfa Seed	Field, Plot	7/79
	Alfalfa Hay	Field	8/78
	Alfalfa Hay	Field	8/79
PFMR89.DAT	Mustard	Plot	6/78
	Mustard	Plot	7/79
	Mustard	Plot	8/78
	Rapeseed	Field	7, 8/79
FDC89.DAT	Corn	Field	8/78
			7, 8/79
FDF89.DAT	Flax	Field	8/78
			8/79
FDWB89.DAT	Wheat	Field	8/78
	Wheat	Field	7, 8/79
	Barley	Field	7, 8/79

The files are organized as follows:

Column 1-5 field or plot code name
6 month of year
7-8 year (last 2 digits)
9-10 crop code (12 different crops)
11 site code (experimental plot or farmer's field)
12-13 sampled projects identification
14-38 cummulative available water in fractions of 1.0 at 30cm depth increments (up to 0-150cm)
39-43 day-time apparent surface temperature minus maximum air temperature differential ΔTsa

.../Table 1. Continued

Table 1. Continued

44-59 optical film densities measured with a SPOT densitometer on a CIR film using neutral, red, green and blue filters, respectively
60-66 yield
67-72 day minus night surface temperature differential ΔTs

Visual analysis of the remaining HCMM data will be carried out using the Photographic Analysis System (PAS ; Dixon, 1980). This is an analogue instrument which allows manual image registration, image input by means of a video signal through a vidicon tube T.V. camera, storage on a video disc, and reconstitution of multispectral or multi-temporal images in various combinations on a colour monitor. It also performs all density slicer operations and has some logical functions.

3. Accomplishments

- Extraction of apparent temperatures from aircraft data was completed.
- Airborne and related ground data were entered into computer (Table 1).
- Ground PRT-5 measurements have been reduced, compiled and plotted.
- Correlation and regression computations were carried out.
- Cloud cover study of HCMM images over the western site was completed.
- Cloud cover over the eastern site is underway.
- Digital data for two scenes have been reviewed and subimages have been placed on separate tapes.
- A methodology for visual image analysis using PAS has been established.

4. Significant Results

Analysis of the airborne data conducted to date shows that the inverse relationship between the maximum surface minus maximum air temperature differential ΔTsa and available water PAW exists in a majority of the data/crop combinations studied. This is true for apparent surface temperatures measured with both airborne scanners and ground thermometers (PRT-5). The ΔTsa vs. PAW distributions for fully developed canopies also appear fairly stable, although the scatter is often quite large. Incomplete canopy cover has a major effect, however. This is evident in several data sets from 22 June 1978 and, depending on crop type, in July as well (e.g., for cabbage).

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Quantification of these effects must await more detailed analysis.

The western site cloud cover study showed large variations, both geographical and diurnal. Night images generally had less cloud cover than daytime images. Locations of cloud cover maxima and minima shifted somewhat from one month to the next, possibly in part due to a low number of images for some areas. In the irrigated area surrounding Brooks, Alberta, the average monthly daytime cloud cover fluctuated between 40 and 60% for June, July and August, 1978.

5. Publications

None

6. Problems

None

7. Data Quality and Delivery

NASA personnel have been very helpful in processing the requested digital data. The third scene is expected to arrive shortly, and an additional scene has been ordered for the eastern site. The digital data appear to be of good quality, although the range of thermal values is not very wide (even for day-time images).

8. Recommendations

None

9. References

Dixon, R.G. 1980. Photographic Analysis System (PAS) Operation Manual. Canada Centre for Remote Sensing. Ottawa. 85p. NOT YET PUBLISHED.

Goodenough, D.G. 1977. The Canada Centre for Remote Sensing's Image Analysis System (CIAS). Canadian Symposium on Remote Sensing, 4th. Proceedings, Québec City. 18pp.